Properties and Productivity of a Salt Affected Saskatchewan Soil as Influenced by Growing a Salt Tolerant Forage and Amendment

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INTRODUCTION

- Worldwide, saline soils are estimated to occupy 397 million ha or 3.1% of the total global land area (FAO 2000). About 20 million ha (30% of total land across Canadian Prairies) of land is reported to display signs of salinity or is at some risk of salinization (Fig.1) in the Canadian Prairies (Steppuhn, 2013).
- Soil salinity is believed to adversely impact SOC stocks in saline soils (Wong et al., 2010), while application of organic amendments and growing salt tolerant crop species can increase soil organic C pools (Ece et al., 2007; Tejada et al., 2006; Akinremi et al., 2000).
- The green wheatgrass forage species are noted to have a relatively high yield on saline soils and also remain palatable later in the season, with the ability to grow and utilize moisture under conditions of high soil salt concentration (Steppuhn and Asay, 2005).

OBJECTIVE

- To reveal how AC Saltlander green wheatgrass interacts with leonardite, humic acid, and cattle manure amendment to influence plant growth, soil carbon accumulation and soil water dynamics including water source for plants (precipitation versus groundwater), water holding capacity and infiltration. This poster covers the effects on soil properties and forage yield.

MATERIALS AND METHODS

- **Study Location**

A saline site and a non-saline site located in the same farm field approximately 7 km southeast of Central Butte SK. Soils in the field are Brown Chernozems intermixed with Solonetzic profiles. Salinity is present in lower slope regions around sloughs and depressions.

- **Seeding and Fertilization**

The experiment was set up as an RCBD design with 4 replications at the saline and non-saline site. The AC Saltlander green wheatgrass was seeded in spring of 2017 at 10 kg ha^{-1}, 25.4cm row spacing. Prior to seeding, all plots received a blanket application of 50 kg N ha^{-1} and 20 kg ha^{-1} P_2O_5 as MAP. Wheat is seeded as border.

- **Treatments**

T_1: Control (CNTL) (no organic amendment application)
T_2: Leonardite (LEO) @ 10,000 kg ha^{-1}
T_3: Humic acid (HA) @ 200 kg ha^{-1}
T_4: Composted steer manure (CSM) @ 10,000 kg ha^{-1}

RESULTS AND DISCUSSION

Table. 1. pH, EC and total soil organic carbon (%) in non-saline and saline site measured in fall 2019. Site was seeded in 2017.

		Non Saline Site			Saline Site		
	Depth (cm)	pH	EC (mS)	TOC (%)	pH	EC (mS)	TOC (%)
CNTL	0-15	7.62	0.53	1.46	7.53	5.33	1.23
	15-30	7.71	0.91	1.09	7.50	7.17	0.97
	30-60	7.70	0.59	0.54	7.57	6.64	0.69
HA	0-15	7.79	0.22	1.26	7.63	5.07	1.42
	15-30	7.83	0.22	0.80	7.66	6.55	0.98
	30-60	7.85	0.67	0.66	7.66	5.97	0.58
LEO	0-15	7.48	1.08	1.68	7.52	5.25	1.50
	15-30	7.63	1.20	0.83	7.61	6.99	0.94
	30-60	7.87	0.75	0.61	7.69	6.12	0.71
CSM	0-15	7.80	0.25	1.54	7.62	4.98	1.28
	15-30	7.77	0.35	0.88	7.39	6.31	0.84
	30-60	7.75	0.41	0.71	7.52	5.99	0.70

Photo 1. AC Saltlander green wheatgrass plots in non-saline (left) and saline soil (right) treatment plots in September 2019.

Photo 2. AC Saltlander green wheatgrass and plot border wheat growth in saline site in September 2019.

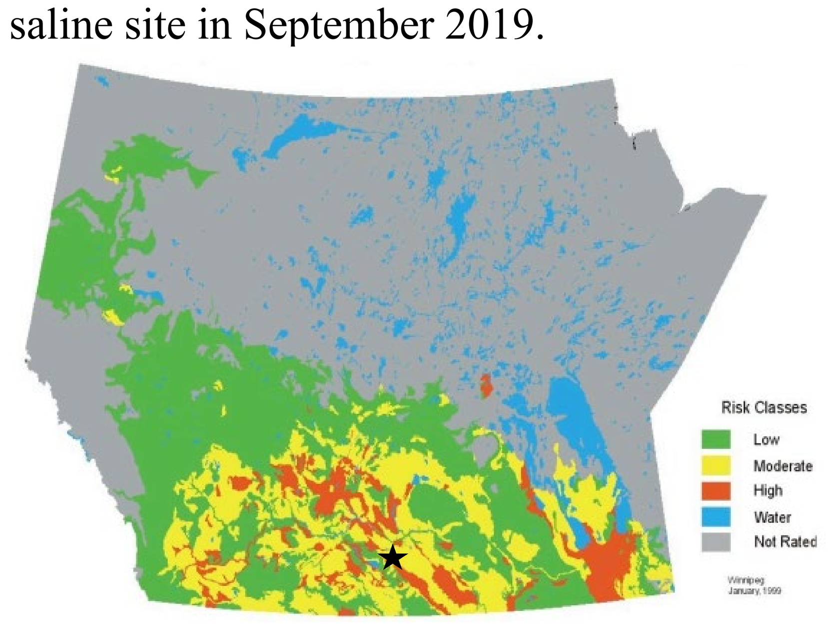

Fig. 1. Canadian prairie soil salinity risk (Steppuhn, 2013)

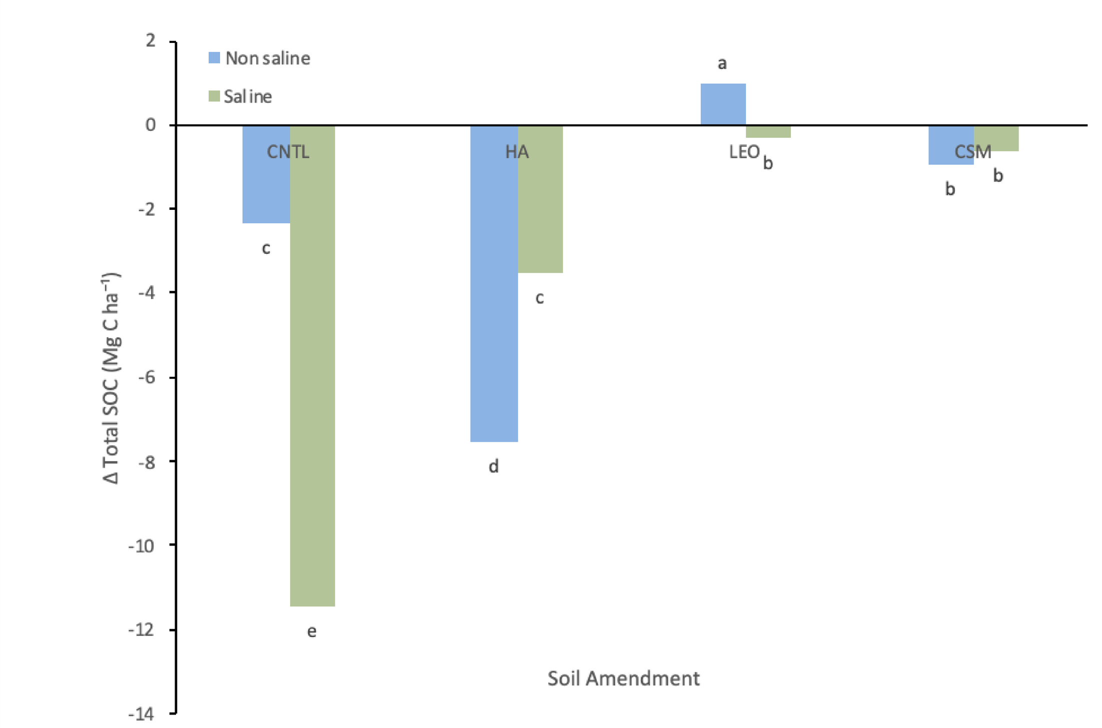

Fig. 2. Change in total soil organic carbon mass from the fall of 2018 to the fall of 2019 in the 0-15cm depth under AC Saltlander green wheatgrass. Seeding and amendments applied in spring 2017. Means within site followed by a different letter are significantly different (P<0.05).

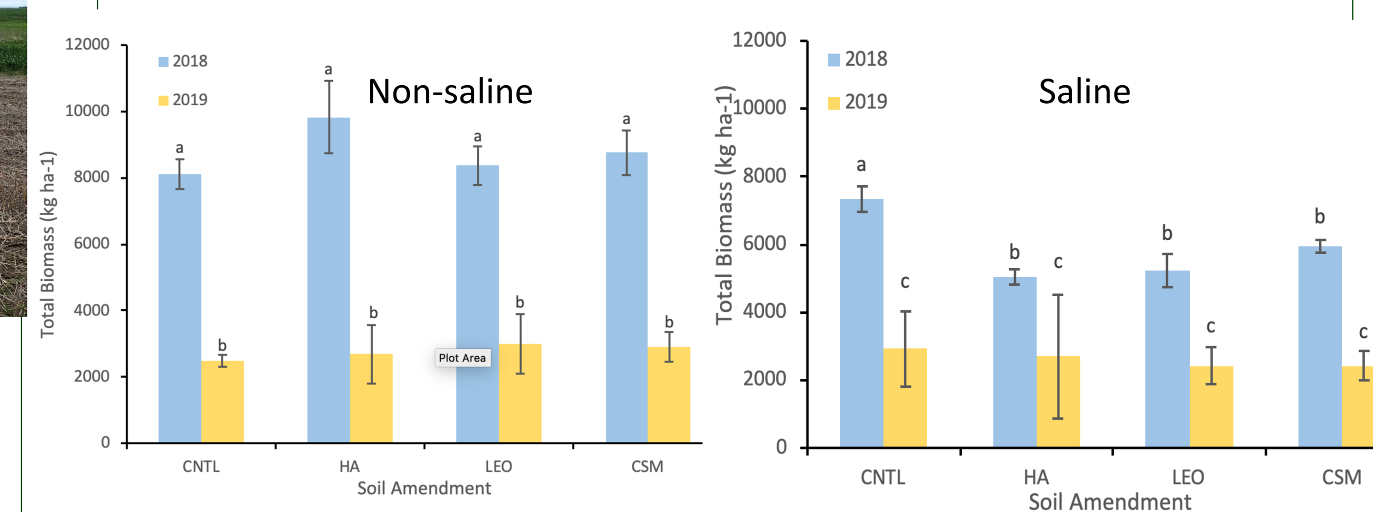

Fig. 3. Total above-ground biomass of green wheat grass measured in fall of 2018 and fall of 2019 in non-saline (left) and saline (right) sites. Means within a year and site followed by a different letter are significantly different (P<0.05).

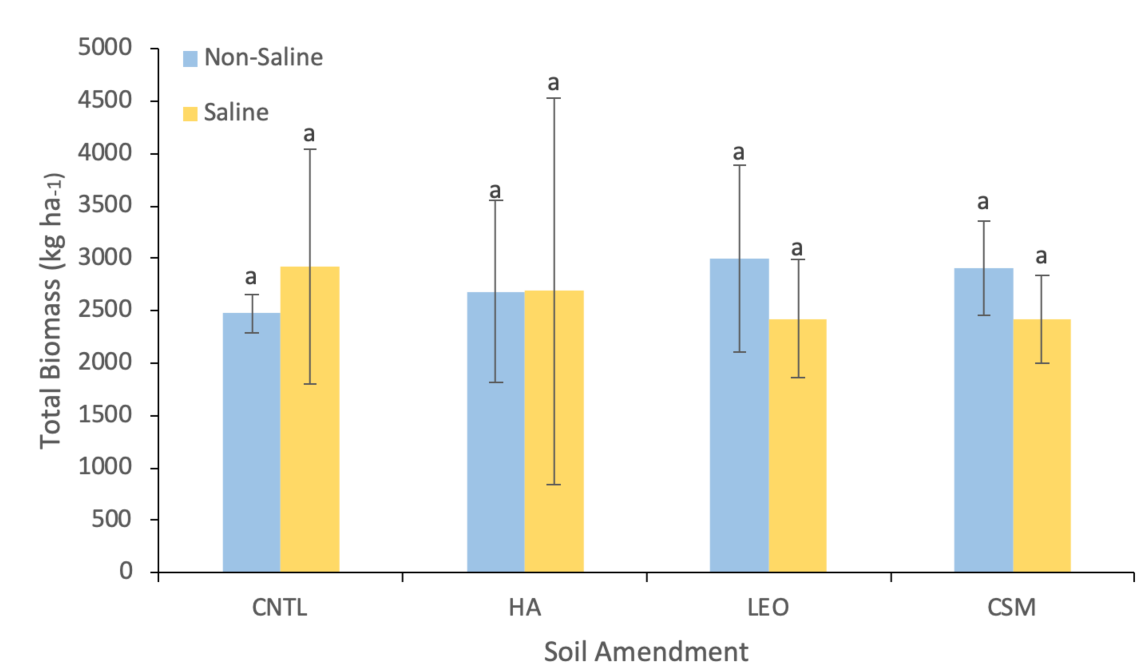

Fig. 4 : Effect of organic amendment on biomass yield of AC Saltlander green wheatgrass in the fall of 2019 in the saline and non-saline sites. Means within each site followed by a different letter are significantly different (P<0.05).

- The concentrations of soil organic carbon in the profiles measured in fall 2019 were similar between non-saline and saline sites (Table 1). Continued carbon input along with reduced decomposition rates in the saline soil may explain the similarity. Leonardite amendment treatment still had highest TOC in fall of 2019, as was found in fall of 2017 (Hrycyk MSc thesis 2018), reflecting its resistance to decomposition.
- The total soil organic carbon mass in 2019 decreased compared to 2018 in control and humic acid amended soils (Fig. 2). Drought conditions in 2019 with reduced productivity (Fig. 3) could explain the reduction. Leonardite and cattle manure amended soil had little change, reflecting recalcitrance of these amendments.
- The pH and EC were similar among amendment treatments in the saline soil (Table 1).
- There was a significant reduction in biomass of AC Saltlander green wheatgrass in 2019 compared to 2018 due to drought. Amendments made in spring 2017 had a negative effect on yield in fall 2018 in the saline site, but no effect in 2019 at either site.
- No significant effects of the amendment applications made in spring of 2017 were observed for biomass yield measured in fall of 2019 (Fig. 4). Unlike previous years where non-saline site yields were significantly greater, in 2019 there was no significant difference in yield between non-saline and saline sites.
- Observed year to year variations in soil properties, forage yields and response to amendments are related to growing conditions, especially moisture.

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